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OUTLINES OF PHILOSOPHIC EDUCATION.

On the improvement of the power of judging and reasoning.

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THE common object of these two *faculties* is to discover and discriminate the various relations which subsist among the different subjects of our knowledge. The term judgment, is applied when, by alternate attention to two objects in juxta-position the relation between them is discovered; the term reasoning is used when that relation cannot be discovered, but by means of a comparison instituted between each of these two objects, and one or more intermediate ideas, having some affinity to both.—Thus, *reasoning* is only an expedient, adopted by the mind, for arriving at a judgment, when the terms of a proposition involves some obscurity; and, accordingly, although it may be a mark of superiority in men, when compared with the lower animals, it is no less a proof of his intellectual weakness, when compared with beings of a higher order. These perceive intuitively, and without effort, *truths* at which we cannot arrive without the painful and tedious process of ratiocination: and we thus find ourselves placed between those who cannot *reason*, and those who do not require it.

That this important faculty is susceptible of cultivation is rendered abundantly manifest from the degree of improvement to which it attains, even in those conditions which seem least favorable to its developement. In rude nations, and in civilized communities too, as far as respects the mass of human beings, no artificial means are used to call forth the natural powers of *reason*; and yet, we find that, even in such circumstances, there is a beginning, a progress, and, in some cases, a remarkable degree of proficiency, in the rise of these intellectual endowments. The child no sooner receives sensations and notions, by means of the external *senses*, than he begins to draw inferences concerning their objects, and to lay up his knowledge in the stores of *memory*; and, in proportion as those faculties are improved, by which we acquire perceptions and ideas, so also are the powers of *inference*, and *deduction*, gradually expanded and invigorated.

It is by minute attention, therefore, to the progress of the reasoning faculties, in the different situations in which *man* is placed, that we shall most successfully lay the foundation of an *Art* of reasoning; for here, especially, according to LORD BACON, we must obey *nature*; observe her dictates, and follow the course which she prescribes. She, then, imperatively enjoins that the first efforts of *art* should be directed to the improvement of those powers of the mind, by which we form clear, just, and distinct notions—by which we discriminate likeness, difference and relation, among the various subjects of our knowledge—as being the only solid basis for an enlightened deduction. It is, indeed, impossible to teach men *to reason until they have been first taught to know*; that is, to form clear and accurate conceptions of the *things* about which they are to *reason*: and, when the former process shall be correctly accomplished, few rules will be necessary to direct them in the latter. Thus, in the different professions and occupations of *life*, we find that men, *reason* easily and justly, from mere *habit*, and without the assistance of artificial LOGIC; and this, because, from their daily pursuits, they have previously formed clear and distinct notions, relative to the several objects about which their reason is employed.

But, though, by this natural *Logic*, as it may be called, the understanding may be so improved as to answer all the practical purposes of life, it will frequently happen, in certain cases where man is called upon to exercise his *reason*, that the assistance of *art* may be extremely useful. We have, accordingly, received from the philosophers of Greece, an *art* for improving and directing the power of reason—a system of rules according to which, in particular cases at least, comparisons may be fairly made, and conclusions justly deduced.

Observing the great progress which had been made in Geometrical Science, ARISTOTLE conceived the project of introducing into the other branches of philosophy the clearness and certainty by which that science is distinguished; without duly adverting, perhaps, to the essential and characteristic difference which subsists between Geometry, and almost every other department of human investigations.

The distinguishing feature of ARISTOTLE's Logic is the *Syllogism*, which, though of minor consideration in the improved system of teaching as discovered by LORD BACON, is, perhaps, worthy of some attention, and may be acted upon in schools predicated wholly on the ancient system of instruction. But the grand and philosophic views of LORD BACON and the complete success which followed his discoveries, has set at defiance all the subtleties of the Aristotelian logic, and brought the art of reasoning down to the level of *truth* and *common sense*.

We here give the probable outlines of the train of thought which occupied the mind of that great man, and to point out to our pupils the cautious and gradual steps by which he proceeds from the beginning to the happy conclusion of his mighty project. They are conducted to the starting post, as it were, from which LORD BACON set out; they travel along by the side of the learned and judicious philosopher; they enter into his secret resolves and purposes; and follow him, with increasing interest and delight, in every subsequent stage of his progress, and through every scene of his manifold triumphs. No exercise can be imagined more conducive to the improvement of young minds. The gradual disclosure of his great plan, tends t enlarge and enlighten their understandings; his method of philosophizing is the best example to guide them in similar investigations; and the brilliant success which attended his labours is calculated at once to excite and encourage them to prosecute their studies with perseverence and alacrity.

LORD BACON maintained that the natural access to science was obstructed by the very means appointed for its cultivation; and that, as particulars precede generals, in the order of observation and experience, what was then placed *first*, ought to be placed *last*, in the order of scientific inquiry.

Freed from the trammels of the ancient philosophy, and anticipating, with steady views, a more enlightened condition of *science* and of *art*, he assured mankind of complete success in all their endeavours, provided they would relinquish the absurd system of following out their inquiries by means of an artificial *Logic*, and adopt the plain, natural method of investigation which all men except *philosophers*, had, at all times, made use of, in their pursuits of every description. He declared, however, at the same time, that the natural method which he recommended was altogether incompatible with the slightest adherenee to the syllogistic Logic, as an instrument of science; and that, to render the reformation available to the purposes of genuine philosophy, it must be *radical* and complete. He hoped, by the aid of experience, founded on observation, and guided by judgment, to change entirely the state of philosophy, and to teach *mankind* an ART which would minister to the improvement of all others.

ON THE BACONIAN METHOD OF INDUCTION.

ALTHOUGH the method of prosecuting philosophical inquiry, by means of *Induction*, has been generally associated with the name of BACON, it is not to be understood that he is the author or inventor of that method. No man ever taught an other his first Induction. It is a mode of inference which the *human being is prompted to make, by the very constitution of his mind*; which regulates his procedure in the ordinary affairs of life; and which would have guided him, with equal steadiness, in the department of *science, and general reasoning*, had he been allowed to listen to the dictates of *nature*. It was only in bringing back Man to his natural, unsophisticated condition, as an intellectual creature, that BACON introduced the *Inductive method* into philosophy. Nor is it to be imagined that Aristotle was ignorant of induction, because he did not admit it into his Analytics. On the contrary, he exhibits, in many parts of his multifarious works, the most satisfactory evidence that, whilst he employed his leisure in constructing an artificial system for others, he himself followed the simple process of nature; as, in his politics, for example, he endeavoured to establish the principle of good government, on an *Induction*, or, more properly, perhaps, an enumeration of particular *facts*, drawn from the consideration of certain forms of government which had actually existed.

The young student may require to be informed that a mere enumeration of *facts* is to be carefully distinguished from an Induction. An inference drawn from an enumeration, can extend no farther than to the particulars enumerated; as the sum total in addition is neither more nor less than the amount of the units contained in it. An induction, on the contrary, always implies the discovery of a principle, as well as the knowledge of particular *facts*; and every inference grounded upon an inductive process is, when technically expressed, the enunciation of a *law of nature*. It is, in short, a general truth, derived from the consideration of common properties in individual *facts*.

The Inductive process, according to the views of LORD BACON, sets out upon the principle already in some degree explained, viz. that, when we observe in many individual substances, the same properties and powers, we ascribe these properties and powers to the whole class of which the individuals observed, constitute a part. For instance, it has been found, upon trial, that *this*, and *that*, and many different *bodies*, gravitate to the *earth*; hence, it is concluded, although experiments have been made on comparatively very few members of the numerous varieties of substances, that *all* bodies gravitate to the *earth*. By a similar process, too, upon observing that *lead* sinks in water, and *cork* swims on its surface, we arrive at a second Induction, or *law of nature*, relative to *gravitation*, as being regulated, to a certain extent, by the specific *weight* of the gravitating body, compared with the density of the medium through which it descends. It is, also upon a principle strictly analogous, although somewhat different in its origin, that, we believe that the *Sun will rise to-morrow*, and that the *tides in the ocean will continue to ebb and flow, in all time coming, as they have hitherto ebbed and flowed*: for, when such expectations are fulfilled, in an indefinite number of instances, they are immediately succeeded by complete assurance, or absolute cer-

tainty, founded upon a firm conviction, that the *laws of nature* will continue to act, *hereafter* as they have all along acted, since the beginning of the world.

A description should here be introduced illustrative of the *cautious* and vigilant character of the *Baconian philosophy*—the severe maxims upon which experiments are to be conducted—the number of *trials*—the exact or imperfect similarity of cases—and, above all, the watchful *scrutiny* into contradictory instances, and *false appearances*. A full account should also be given, in this part, of what Lord Bacon calls his *ascending* and *descending scales*. By the former of these processes, as might be conjectured, the mind advances from particulars to the next more general step, and proceeds again, in the same way, to others still more general; till, by a series of progressive movements, it arrives at the most general conclusion, or *law of nature*. In the order of the descending scale, the mind sets out in possession of these *laws of nature*, or general doctrines; and thereafter, applies, with the characteristic caution and reserve of the Baconian School, to the explanation of particular phenomena.

The mistakes into which men have fallen, in the prosecution of the *Inductive method*, are to be ascribed not to this *mode of reasoning*, but to the *reasoners* themselves; and, particularly, to their *neglect* of the several marks whereby a *perfect*, is to be distinguished from an *imperfect* induction. They have persisted in overlooking minute differences, in cases apparently similar; or they may have drawn a general conclusion from too small a number of instances, seizing upon a principle not sufficiently established by decisive experiments. Hence, it has come to pass that more false *theories*, and dangerous *notions*, have arisen from hasty *Inductions*, than could ever be imputed to the use of *syllogism*. Omens, prodigies, *lucky* and *unlucky* days, of which we read so much in ancient history, are all to be traced to hasty *inferences* from *facts* not inquired into, or not clearly understood; as are also those mystical associations which subsist in the minds of most men, between the occurrence of one event and the expectation of another; which ages of knowledge, and the most enlightened education, have not been able completely to dissolve.

No plan of study was ever more fully justified by success than Lord Bacon's. It is truly surprising how soon, and how widely, the spirit of his philosophy pervaded every department of science. The student of *Nature*, at once, forsook the ancient method of philosophizing, and eagerly followed the directions of Bacon, in investigating the laws of the material world, and establishing facts which have been acknowledged the basis on which all modern philosophers have raised their systems.

Among the many happy effects resulting from the reform introduced by Lord Bacon, may be mentioned the encouragement which was thus held out to men, in every country, and every condition of life, to enter upon the study of *Nature*; and, by observing, comparing, and recording *facts*, to contribute their share to the common stock of knowledge. Philosophy was now brought down to the *level* of the most ordinary abilities, and was prosecuted according to the natural conceptions of mankind. A new and easy path was opened, in which not only the *learned*, but the studious and inquisitive in every rank of society, might walk with safety and success. It was soon after his time, accordingly, that the republic of letters, properly so called, received its establishment, and was endowed with the true riches of genius and freedom. Societies were formed for the express purpose of collecting and inculcating knowledge. Kings and Princes encouraged the rising spirit of industry and research. Theory and experiment, speculation and practice, went hand in hand; and a reasonable prospect was now entertained of uniting the labors and genius of all the nations on the face of the earth in promoting the interest of *science*. Never could it be more truly said than now, that "Wisdom was justified of her children;" for, soon after this great Luminary appeared, a band of ingenious men arose, who made the most striking discoveries in Natural philosophy. Torricelli announced the pressure of the atmosphere. Harvey discovered the circulation of the blood. Huygens perfected the telescope; and applied the pendulum to clocks. Leuenhoeck, by his microscope, laid open a new world which had formerly been concealed. Boyle engaged in his physical experiments. Halley attempted a theory of the comets. Bradley subjected to regular laws the aberrations of the fixed stars. The great Newton *analysed the rays of light, and taught the gravitation of worlds.*

Though Lord Bacon directed the application of the Inductive method of reasoning chiefly to the discovery of the laws of the material world, it may, notwithstanding, be also applied, in its leading principles, at least, to investigate the properties of the *laws of mind*. It is true that experiments, literally of the same kind with those to which matter is subjected, cannot be made upon the *thinking substance*; but no one will deny that experiments, equally well adapted to the *nature of mind*, may be contrived, and executed, with success. In truth, although Lord Bacon, as has been already observed, applied his method of *Induction* chiefly to natural science, the spirit of his philosophy was soon, likewise, extended to the study of *mind*. Mr. Locke, in his essay on the human understanding, trode exactly in the path which Lord Bacon had pointed out. Dr. Reid, the follower of Mr. Locke has left us some excellent specimens of the Baconian Logic, on intellectual and ethical subjects, and prove, by their successful use both of *analysis* and *synthesis*, that this mode of investigation may be profitably pursued in the philosophy of *mind*, as well as in that of *body*.

Considering the nature of the reformation brought about by LORD BACON, and viewing it, as it ought to be viewed, in the light of a simple return to those principles of unsophisticated *reason*, it was not be expected that any material addition to the rules of investigation, considered as an art, could be made, either by his immediate successors, or by more modern philosophers. The *Novum Organum* professed to accomplish little more, than to induce men *to reason* in the ordinary affairs of life; *to rescue* them, in short from the dominion of art, and to restore them to the clear *light* and unfettered liberty of *nature*.

The art of reasoning like all other arts, can only be acquired by habit; not by the mere knowledge of speculative rules. Ten thousand treatises might be written on the arts of *spinning* and *weaving*, and the rules contained in them might be fully understood, whilst yet neither *yarn* nor *webs* would be produced, to honour the ingenious author. In learning the art of *reasoning*, accordingly, the young *artists* must submit to be *instructed* and *exercised*, in a manner not less practical than the apprentice to a common trade. He must be subjected to authority and discipline: compelled to exert his talents in general; and particularly those which respect the perception of truth, and the relation of things: and these elementary steps once taken, and persevered in, it will be easy for him to *direct* the faculty of *reason* to whatever subject may be brought before his mind, without any immediate reliance upon abstract doctrines of *logic*, or theories of *reasoning*.

The first step, towards good reasoning, consists in taking clear views of the subjects concerning which the determination of the mind is to be made; and, in order to invest the perceptive powers with this invaluable HABIT it is absolutely necessary, in the very commencement of a philosophical education; to cultivate, by means of regular exercises, the faculties of *attention* and *observation*.

The chief improvement in the art of reasoning, therefore, which we can anticipate, or which, indeed, seems at all practicable, will arise from the manner of *teaching* it; not, as at present, by mere speculation on the nature of mind, or by abstract precepts founded upon doctrines not well understood; but by a constant and regular exercise of the several faculties which are employed in logical deductions, on subjects selected and explained by the *teacher* for that express purpose. There is no other way of teaching youth a true and rational *logic*, except that of inducing them to *think* and *reason*; and, to render education effectual for these important ends, he who conducts it must have the means of exciting *industry* in all his pupils, of assisting the willing, encouraging the irresolute, directing the ignorant, compelling the retractory, and of rewarding the successful. When the exertions of the students are *optional*, they will neither be constant nor uniform; and, indeed, we might as well look for effects without causes, in the material world, as for *activity* and *diligence* in youthful minds, without a concurrence of motives derived from the discipline of the school, the authority of the *teacher*, and from the feelings of *emulation* which he may have succeeded in awakening.

Teachers who feel a concern for the improvement of their pupils, must submit to constant and painful labour; directing their *zeal* and *talents* to the means of cultivating endowments of which the pupil hardly knows he is possessed; of fixing attention upon subjects little calculated to arrest the juvenile imagination; and of drawing forth regular efforts, where there are so many temptations to remissness. It is in vain, therefore, to complain of defects in the art of logic. The defect is in the art of *teaching*—a defect for which no artificial system of reasoning can, in the smallest degree, compensate—inasmuch as no degree of genius, no extent of resources on the part of the *teacher*, can make up for his unskilfulness, or for his negligence, in not producing regular, animated, and increased exertions, on the part of the student. It must, however, be admitted, that, in all the departments of science, and of business, many persons have attained to high and exalted exercises of the reasoning powers, without having gone through the discipline of a logic class. But such persons must have gone through a similar or analagous course, either under their own, or some other private direction. Some may be favored with stronger powers of intellect than others; or may have been placed in more favorable circumstances; but no man ever acquired the *habit of reasoning well*, on any subject, except by reasoning frequently and regularly. Intellectual habits require frequent and strenuous exercises of the intellectual powers. We repeat that vigour of intellect, an active imagination, and a correct judgment can be acquired in no other way than by a constant and regular exertion of them; and therefore, to imagine, that young persons may be *flattered* or *trifled* into the acquisition of such habits, without sedulous and constant *labour*, is not only to deceive ourselves, but grievously to mislead those whom we ought to instruct, and whose exertions we ought to guide. The student should be informed that, at a given point, beyond a certain portion of difficulty and labour, on his part, are placed the most valuable acquisitions —*Knowledge*, *competency* and *respect*: and that, in order to *realize* these good things, steady and well directed exertion is a condition as indispensable as the cultivation of the soil is to the production of a crop.

Such are the views we have of a correct system of elementary education, the ruling principle of which is to accommodate the subject matter to the capacity and actual progress of young persons, to awaken a desire for information, and keep alive

their interest in the several subjects which are brought before them, to excite instructers to qualify themselves to teach their pupils philosophically, and, if possible, to introduce a more efficient mode of inculcation into our schools, both public and private, than is acted upon at present. Although we are willing to allow that *children may teach children*, and thereby diffuse a limited knowledge of a few of the elementary branches of education among the poorer classes of the community, yet we are by no means convinced that the popular system now in vogue is destined to be the AMERICAN NATIONAL SYSTEM. The *pioneers Bell, Lancaster* and others are preparing the public mind for the introduction of a more philosophic and permanent system. The world is indebted to Lancaster for an improved organization of charity schools, and the adaptation of his system to rigid economy, but the *immortal Pestalozzi* and his disciple *Fellemburgh* have brought to perfection a system of *mental culture, industry* and *economy*, which, when known in all its details to the American people, will, we hesitate not to predict, be embraced and adopted in all places of systematic education.

ON THE NATURE AND UTILITY OF ORAL INSTRUCTION.

THE suitableness of the materials which form the ground-work of lessons for *oral instruction*, is no doubt, a consideration of primary importance, but it is not the only requisite which must be attended to in preparing a connected course of instruction for the improvement of youth just entering the threshold of learning.

When the sole end in view is the communication of *knowledge*, the natural connection of the subjects to be explained will, in all probability, dictate to the teacher the order and manner which ought to be pursued, and at the same time deprive him of any alternative as to the succession of the different topics. But in the case under consideration, as the subjects are chosen with a reference to the improvement of the pupils in the use of their intellectual faculties, rather than with the view of putting them in possession of any class of facts, the method of instruction will be calculated to meet the natural growth of the understanding, and to follow the order in which the several powers of the mind are found to develope themselves.

Whatever, therefore, may have been the order in which the teacher acquired his own knowledge, he must manage it, when he delivers it to his pupils, in such a manner as will best accord with the natural procedure of those powers of mind which he wishes to address, and with the generation of those habits which he wishes to implant or to invigorate. The subjects, too, must be regarded as new, or as very imperfectly understood; and those parts, accordingly which are simplest, and the most easily conceived, ought to be first presented to the mind of the pupil, so to be followed up by such as are more complex or profound. The Tree of Knowledge, like the natural tree, has its root, its stem, and its branches; and as the mind observes these connections in forming a notion of the one, so ought this analogy to be attended to, in guiding its conceptions of the other.

Again it is sufficiently obvious, that knowledge of an abstract and general nature cannot be successfully communicated without a previous acquaintance with the particular facts upon which such knowledge is founded. As the bodily eye comprehends individual objects only, and attains not to the knowledge of complicated substances but by means of a reflex process, originating in the mind; so the intellectual eye follows a similar order in perceiving the various parts of a complex subject, commencing with separate facts, and ascending by regular steps to the comprehension of the whole. Hence, it is fruitless in the extreme for him who prepares lessons or lectures, to be delivered to young persons, to enter into a detail of theories and systems, and to give criticisms on their leading principles, while no means have been used to make them acquainted with the basis on which they rest. There may, indeed, be in a class, a few individuals of riper age, or of superior talents, who will be able to accompany the teacher in his profound speculations; but the greater number would be left behind to grope their way in the dark, "deserted in their utmost need" by him who ought to have conducted them.

Familiar with the subject himself, and having ceased to remember the exact order in which he acquired his knowledge of it, the teacher is very apt, unless he keep constantly in his eye the circumstances, or to whom he is lecturing or explaining, to pass over certain steps in the train of thought, absolutely essential to the proper understanding of his discourse. To guard against this oversight, imitating the example of Mathematicians, as far as the different nature of their subjects will permit, he should proceed through a succession of positions clearly and closely related, and thus maintain an unbroken connection, from the first presentment of the doctrine to its full and complete exposition.—One great advantage, too, attending this method of *oral* instruction, accompanied by the text books of the school, is the facility with which subjects may be moulded to suit the acquirement and capacity of the pupils, and to further the general purposes of their education. The teacher, therefore, regarding his pupils as having yet to learn, not only the branches of science which he undertakes to teach, but even to THINK and arrange their ideas on every other subject, must have respect to their *ignorance* rather than to his own knowledge, in his *instructions*. His lessons ought to be measured, not by what he can give, but by what they can receive; and reflecting

that his pupils come before him to learn what is useful, and not to admire what is ingenious; he must sacrifice his elegance, and talent for *research, and be contented to teach plain things in a plain way.*

This method of procedure naturally leads not only to a form of oral lessons well calculated for the communication of knowledge, but also to a peculiarity in the mode of teaching, not less adapted to excite the interest and conciliate the affections of the pupils. Discourses addressed to children ought, perhaps to be founded on the model of conversation, rather than on that of a regular and methodical harangue. He should arrange the heads and leading topics of his discourse, with the view of aiding the comprehension of his pupils, rather than of defining the exact limits which separate them from each other. The teacher's oral instructions ought to abound with illustrations. Whenever there is the smallest obscurity, or the slightest chance of not being understood, care should be taken to make use of such comparisons and similies as will throw in light and direct the reasoning faculty. Even where there is no particular obscurity; the mind is relieved by means of illustrations, from the unnecessary severity of exertion and intensity of thought.

The peculiarity of address alluded to, and which will naturally suggest itself to the teacher whose chief object is to be understood; may be exemplified in a great variety of ways, and among others, by throwing the matter connected with the more important topics of his subject, into the form of questions When a difficulty is stated, or a solution wanted—or, indeed, whenever the nature of the discussion leads to, or justifies it—the teacher will find some advantage in putting a leading question to the pupils, stopping a short time to give them leisure *to think*, and, as if he expected some one of them to return an answer. In such circumstances, the more attentive and ambitious among them, will consider it as put to each of them individually, will cast about in their minds for an answer, view the subject in all its lights and bearings, and silently settle with themselves what would be the reply.—On some occasions we have even put it in the power of the pupils to stand up in their places and express their opinions on the point under consideration; and many of the answers given on such emergencies have displayed much ingenuity and readiness of judgment. This experiment, however, requires great caution and delicacy. Failing in such a case, arising from a trifling or ridiculous answer, would not only defeat the immediate object of the teacher; but it would, in other respects, tend to repress a becoming emulation, and create such a fear of contempt as would deter modest youth from less hazardous enterprises. There can be no doubt, indeed, that the activity and vigilance, which appeals of that kind produce, are highly favourable to mental improvement and progress in study; and a teacher who has gained the confidence and esteem of his pupils incurs but a very small risk in occasionally repeating them.

The silence and composure of the pupils, at such times, are very impressive, and prove that the trial of skill and promptitude devised by their instructer, does not fail to awaken a deep interest. Even when no answers are given, the practice is not altogether without advantage, for a comparison is instantly made by the diligent pupil, of the explanation given by the teacher with the reply which he was prepared to make. If, indeed, a successful appearance is made by one or more of the pupils, the effect is both great and permanent, tending powerfully to rouse Emulation, and confirm industrious habits. I remember well, says Dr. Jardine, and the anecdote is worthy of being recorded, the striking effect produced on the minds of his students, by an instance of great simplicity and candour, on the part of the late venerable Dr. Reid, when he was professor of moral philosophy in the university of Glasgow. During the hour of examination, the students were reading to him a portion of *Cicero de Finibus;* when, at one of those mutilated or involved passages which occur in that work, the student who was reading, stopped and was unable to proceed. The Doctor attempted to explain the difficulty; but the meaning of the sentence did not immediately present itself. Instead, however, of *slurring it over*, as many would have done, "Gentlemen" said he "I thought I had the meaning of this passage, but it has escaped me; I will therefore be obliged to any one of you who will translate it." A student, thereupon, instantly stood up in his place and translated it to the Doctor's satisfaction. He politely thanked him for it, and farther recommended the young man for his spirited attempt. This incident had a most powerful effect upon the minds of all the other students, while all admired the candour of that eminent professor; nor was there a single difficult passage which was not afterwards studied with more than usual care, that the precious opportunity for distinction might be seized. Powerful, indeed, and lasting, are the impressions which such incidents make on the minds of ingenuous youth. They often contribute more to encourage industry and sustain resolution, than formal precept, or even affectionate remonstrance. Opportunities of producing such impressions, therefore, ought never to be neglected.

In studying to be useful, as a public or private teacher, a person must extend his system of instruction to the language and capacities of his pupils. The phraseology of science, and the technical terms which must be employed in the very introduction of his professional duties, are necessarily in a great measure new to the pupils, commencing a course of scientific study. It cannot, accordingly, fail to puzzle the juvenile beginner to have to struggle at once with an abstraction in the thought, and with an obscurity in the language. The teacher, there-

fore, should adopt, particularly at first, a plain, perspicuous, and even familiar mode of expression. Indeed, the form of *oral* lessons of instruction, here recommended, naturally leads to these qualities of style, and encourages that simplicity in the structure and colloquial ease in the manner, which characterize extemporaneous instruction. Sentences rigidly measured, and precisely rounded, are apt to bind up the meaning; at all events, they answer much better to be read than to be heard.

The explanatory method of teaching, brings the mind of the instructer into closer contact with that of the pupil, than the repetition of rules or repeated readings; it accommodates itself more easily to the wants of the learner, enables the teacher to elucidate or explain what has not been fully conceived in the book lesson, to change the mode of illustration, to relieve the attention, to excite the curiosity, and to direct, and anticipate, and to assist, in a great variety of ways, which are in vain to be expected from committing the words of an author to memory, or by the fanciful method of dictation which has unhappily for our youth been inconsiderately introduced, not only into our schools which are supported by the hand of charity, but into others, where a more efficient mode of instruction ought to have been adopted. We trust, however, on mature reflection, and a little more experience, that improvements will by degrees be admitted by the directors of them, which may ultimately render those institutions better adapted to mental cultivation, and more beneficial to those who are instructed in them.

It will be admitted that teachers may possess great talents and extensive knowledge, and yet be deficient in the habit of extemporaneous instruction. But as there are few qualifications more necessary for the proper discharge of their duty, this is an acquirement which young teachers should spare no pains to secure; and it may be remarked, that those who are greatly deficient in useful and popular talent, are on that very account disqualified for holding the office of private or public teaching.

The professional Art, so to call it, comprehending that of managing and instructing young persons, morally and scientifically, requires an asssmblage of qualities which are not always found united — An ardent and diligent search for the particular *knowledge* required—the arrangement and adaptation of it to suit the purposes of those to whom it is to be communicated—the kind, prudent, and discreet management of different characters—the wise administration of discipline—firmness and self-possession in bestowing praise and in inflicting censure —readiness to meet unexpected demands for information—the removing of obstacles, and the solving of difficulties—are all required of a TEACHER.

Before we close this article we would observe, that, when instruction is delivered *extempore*, as the expression comes warm from the active *thought* and animated feelings of the teacher, there is produced in the *moment* a *species of sympathetic influence* between him and his pupils, which it is not easy to describe, but of which the effects are well understood He, too, who speaks *extemporé* can look around him with freedom. and form an estimate not only of the attention which is given by the students, but also of the interest with which the instruction is received. He perceives from the expression of the countenance, and the attitude of the body, whether the *mind* of the student is caught and carried along by the flow of argument, or whether he is left behind, labouring to keep up with the progress of the discussion. The advantages arising from this intercourse between the mind and the eye, in a class of students are neither few nor unimportant. They have been appreciated more or less by all teachers, and turned to a practical use by such as had sufficient skill to mark their tendency. I have heard, says Dr. Jardine, from the celebrated Dr. Smith, who was long professor of moral philosophy in the University of Glasgow, that almost every session there were some of his students, from whose countenances and general behaviour he was enabled to judge whether his lectures were fully understood There was an intelligent and composed posture of the body which he could easily distinguish from that which denoted a doubtful or unsatisfied state of mind. "One session," said he, "I observed an intelligent student who generally sat in the same place, with his back to the wall. When he perfectly understood the lecture, he sat with his body bending forward in the attitude of animated attention; but whenever he found me above his *level*, he threw his body back to the wall, and continued in a careless posture. That was a signal to me. I instantly retreated, took up the subject in another form; and never ceased my efforts till my *marksman* bent forward from the wall, and was restored to his attentive position. Then we went on harmoniously together."

ON THE UTILITY OF DAILY EXAMINATIONS IN SCHOOLS.

It is not to be expected, that the mere round of book lessons, nor the performance of oral instructions, accompanied with the most minute illustrations, will prove sufficient to furnish youth with facts and reasonings on which to exercise their talents, whether for thinking or writing; and it is from this conviction, that the practical business of teaching, so to call it, is made to embrace a regular place of a daily examination, as the basis of all the other exercises which are enjoined in the several classes of regular and systematic schools.

In conducting these examinations, the questions put to the pupils should not be of that description which necessarily suggest their answers, nor such

as may be answered categorically without being attended with any certain proof that they are well understood. On the contrary, the questions addressed to the pupils should be expressly calculated to expose carelessness on the one hand, and on the other, to draw forth the more pleasing evidence that they have been actively employed, and can already exercise the intellectual habits of memory, judgment, and reflection. The experience, and even the abilities of the teacher, may be easily discovered by his method of conducting an examination. *Prudens interrogatio dimidium est scientiae.*—Among so many young persons of different ages, capacities, and habits, the same questions cannot be put indiscriminately, and with equal advantage to all; for, while there are some who find no difficulty in comprehending the object of an interrogation, and in giving a suitable answer, there are many who, from inattention, defect of memory, want of intellect, require that the form of the question should be varied, and even that hints should be supplied to aid the recollection In such cases, the skill of the examiner is put to the test, in accommodating his queries to the capacity of the pupils, in giving courage to the diffident, in removing perplexities, and in suggesting to all, the use of their resources.

To give additional exercise to the minds of the more advanced, questions are occasionally put, which cannot be answered without entering into an enumeratson of particulars, on which general doctrines or truths are first founded, or into a detail of proofs and arguments by which propositions on certain points have been established or overthrown.

The manner of putting questions, likewise demands the attention of the teacher. There are many students who, though they possess sufficient information to answer the questions addressed to them, cannot overcome the embarrassment into which they are thrown by their natural timidity; and young persons of this character, it is very clear, may be suddenly checked, by an abrupt or impatient manner, on the part of the teacher. To discharge this duty well, therefore, the preceptor must proceed with kindness and affability; and often satisfy himself with gathering an answer from an imperfect expression, rather than increase the embarrassment of the pupil, by recurring to the question. Sometimes, too, he will find reason to blame himself, for putting questions which ought to have been preceded by others of a simpler nature; and, on other occasions he may find it necessary to depart from the order of the lessons, and to adopt another of explanation more suited to the talent or progress of the individual. In both those cases, the object of the teacher will be the same—an endeavour to carry the pupil forward through all the intermediate steps of the subject till he come to the point under consideration, and ultimately to the conclusion of the article under discussion.

The advantage derived from such regular, daily examinations, are too obvious to require to be pointed out. They are the touch-stone by which all systems of instruction are tested! This method, were it acted upon generally, would strike at once, at the root of the passive modes of teaching, which are too prevalent in the schools of our country

The responsibility to which the pupils are subjected, in this method, and the constant demands which are made upon their attention, have a most powerful effect in exciting activity, and in training the mind to precision, in its various operations.—Besides the practice now mentioned, presents many opportunities to the teacher of illustrating the more difficult parts of the subject to which his pupils' minds are directed, with greater force and effect, than he possibly could command in a formal round of prescribed book lessons. Discovering, also, from the answers received, the particular obstacles which impede the progress of the student, the point where his comprehension fails, and where mistake succeeds, the teacher is enabled to accommodate his instructions to the particular circumstances of each individual, and to put all, in the way of understanding the subject with greater distinctness and accuracy. Animated by the interest which his pupils manifest in this mode of tuition, he will occasionally find his powers of communication and address raised above their ordinary level, so as to make a deeper impression on their youthful minds, and will, in such moments, naturally lead their imagination from the present scenes of labour and difficulty, to future views of honour, usefulness, and distinction, in which they may hope one day to participate; and thus effect what will seldom be accomplished by a *mute instructer*, a *book*, or by admonition. In such circumstances, also, he may frequently seize a favorable opportunity for rousing the indolent, for encouraging the diffident, for directing the spirit of the adventurous, and for bringing down the ignorant pretensions of the petulant and assuming. In truth, it is impossible to calculate the happy effects of such unreserved, affectionate communications on the varied minds of ingenuous youth

It may be farther remarked, that this method of conducting daily examinations in our places of education is essentially necessary to qualify the teacher himself for the successful discharge of his duty If teaching be an Art, as we apprehend it is, and an art, too, of the most difficult kind, expertness in it can be acquired inno other way, than by practice and observation. How eminent soever the abilities of a preceptor may be, he is not thereby qualified even to conduct a course of instruction suited to the various capacities and acquirements of his pupils, unless hehas had experience in teaching on the *oral* and *explanatory* method. Destitute of experience, as a practical instructer; he might, indeed, like Rosseau, frame an imaginary scheme of

education, which, however, like the system of that eloquent writer, would prove completely inapplicable to the purposes of ordinary life.

We may condemn or ridicule, as much as we please, the scholastic mode of education, but there certainly never was a wilder scheme devised by the perverted ingenuity of man, than that of attempting to improve the minds of youth, and to create intellectual habits, by the sole means of book lessons, or by the *dormatizing* practice which is pursued in many of our schools, of one pupil pointing out to another, the mere words of a lesson, without the ability or inclination to explain even the meaning of the words or the ideas of the author to him, or without any intercourse between the teacher and pupil. By the ancient method of instruction, a high degree of acuteness and discrimination was produced in the mind of the student, whereas, the mere passive instructer does nothing, and can expect nothing, but what may happen to result from the voluntary efforts of the student himself.

To be useful, a teacher must found his mode of instruction upon a practical knowledge of the dispositions and habits of youth; and there is no other means by which this knowledge can be so well acquired as by a constant intercourse with the students, in the way of examination. He has, thus, opportunities every day of observing the effects of his instructions; how far they are comprehended by his pupils, and what may be wanting, on their part or his own, to clear doubts and remove difficulties.—He becomes, in a little time, nearly as well acquainted with their minds as with their faces, and can ascertain the precise-measure of their progress and advancement.

One of the chief difficulties which occur in conducting the examination of the various classes of a numerous school, is that of preserving the attention of all the students during the time it is going on; for as only a few of them can be examined in the same hour, the remainder, who have no prospect of being called to an account, may be apt to become careless and inattentive. Among the more thoughtless, it is very clear, the attention bestowed, during the examination will be in exact proportion to the probability that they themselves shall be examined; and such youth are generally extremely expert in their calculations on this point, whenever they have reason to imagine that the moment of scrutiny returns at stated intervals. An hour, too, spent every day with the mind unfixed and unoccupied will occasion a degree of injury, in relaxing the habits of application, and in confirming those of idleness, which will not be compensated by all the knowledge which a pupil, in such circumstances, has any chance of obtaining.

It is here, then, that the experience of the teacher will manifest itself, in devising expedients to defeat those calculations of the pupil. For example, he will not examine the class in any stated order: he will occasionally call upon the same individual at two successive hours, and even twice in one hour: and, as a check to open negligence, he will sometimes fix upon such as appear least attentive, and thereby expose them to their fellow students. Nor is this all: for, to repress more completely every habit of idleness, and to compel the slothful to labour, he ought, on certain occasions before the examination begins, to call out a number of the least industrious and attentive, who are commonly distinguished by unequivocal marks, and require them to prepare, in their places, a written account of their morning lesson, from memory, or from their class or text books; of which they are to read, before the dismission of the class, as much at least, as is necessary to make known their activity or negligence. This practice, which is occasionally extended to all the students, and to all the various branches of scientific study, we have found attended with many good effects. It secures the attention of such students to the morning lessons; it accustoms them to abstraction, as they are thus made to carry on a different train of thought from that with which the rest of the class is occupied; and, at the same time, it prevents the careless from disturbing the industrious and well-disposed, during the important business of the examination. There are few, indeed, who would not rather endeavour to make a good appearance in the ordinary business of the class, than to have their negligence exposed, and their character marked, by being singled out, in this manner, to give an account of their studies.

This method of conducting the daily exercises of a school, is extensively useful; it causes care and industry among the pupils, excites emulation, and secures improvement; it levels a death blow at the root of all whimsical schemes which are too often palmed upon the community under the beguiling appellation of *short systems*; it strikes *dumb* the impudent twenty lesson men; it appals the visionary, who purposes to teach *thousands* by a few babbling dictating monitors, or with a magical pointer, directing the eye to some fixed lessons which may be learned by the ear, and repeated as well by a blind child as by one that can see; it exposes the vain egotistical pedant: it puts a rational system into every intelligent parent's hand, and enables him to teach his children more useful knowledge at his own fireside, than they frequently acquire from the boasted systems which the popular rage of the ignorant has sanctioned.

PESTALOZZI, No. 7.

The distribution of time, and the application of modern employment to the improvement of the understanding and health, so as to make instruction a recreation, and relaxation a lesson, constitute some of the most interesting and important features of

the method of Pestalozzi. I am aware, that in giving my ideas of this system, my own mode is desultory; but this is unavoidable, when the purpose is to give comprehensive views of a most multiform though simple subject, for any course of lessons or any particular branch of instruction, would occupy more space in print than two or three numbers of your *Academician*. I shall therefore, now give you some ideas of the manner in which this education by recreation is conducted, and use the occasion to introduce examples of the results of instruction in this mode, by stating the manner and the subject, and the mode or resolution, exercise and demonstration, as either is called forth.

Early rising and exercise in the open air at dawn, are habitual parts of the system. The cleanliness of the person, bathing at proper seasons, botanical, mineralogical, and geological ideas, which having their elements devolved by oral explanation in incidental conversation, prepare the young mind for the future developement of the laws by which science has connected the several branches with others on which they depend—such as chymistry, with mineralogy, geology and the composition of plants; as botany and perspective are connected with geometry and the like. An excursion of an hour refreshes the spirits after sleep, invigorates the body, and prepares the appetite for the morning repast, and a short interval after breakfast, calls the young students to their classes—and their exercises continue about an hour, sometimes an hour and a half—when, if the weather permits, some exercise in the open air, succeeds for another hour. The hours of application within doors, do not usually exceed more than four or five hours in each day; but there is no part of the time, from sunrise to sunset, that is not rendered subservient to the inculcation of knowledge, in the strictest terms of reasoning and fact; so that to conduct a school of this kind, the teacher must enter into it with a mind tempered and well informed, and disposed to make it, and feel it as a pleasure to himself. The usual hours within doors, are from 7 or 8 to 9, or half past 9 or 10; from half past 10 to half past 11 or 12 at noon—thence to 2 o'clock, for recreation, or gymnastic exercises in the open air, preparatory to dinner, and half an hour after dinner. From 2 to half past 3—from 4 to half past 5 or 6 in the evening — The setting sun is the signal for repose, as the rising sun is for recreation.

In order to afford some ideas of the proceedings in the school, I shall take up the practice of a class of boys, who have been between two and three years educated in this way; and of the various ages, between six and ten years old I shall state nothing but what I have seen, and know to be true, and concerning children, of whom, two were my own. It must be kept in mind, that not a single book was used at this stage, nor during any part of the three years; but that every exercise was conducted by the eye seeing objects to which it was directed, the ear hearing the explanations given of the object seen, and the hand drawing where the subject required it, the object of study on a slate.

The mode of arranging the classes is according to the degree of aptness of the pupils; those of capacities, nearly equal, being formed into distinct classes, and the next, transferred progressively to a more advanced class, as none is permitted to leave a class, until he shall have become perfectly competent to the clear explanation of every thing studied or made one exercise in the class to which he belongs—it is not getting a lesson by heart, he must be competent to explain whatever he is asked in his class. The exercises which I shall give, will therefore, serve to explain the manner of the exercises, and the extraordinary efficacy of a method, by which boys of ten years of age, or under, investigate subjects, which, in the ordinary forms of education, even in our colleges, would be considered as accomplishments worthy of a professor.

The boys having taken their seats on benches, so that each shall have a desk, his slate and pencil before him, and all in the same direction. The teacher signifies that they are about to analyse some geometrical figures, to which he points; a large tablet, or black board, prepared for the purpose, being suspended in front, on which the figures are promiscuously delineated. In a former number, I gave a specimen of the analysis of angles, so far as the properties of the lines or limits of an acute angle; this exercise proceeds out of the principles of the former. The teacher, or one of the pupils, who perform all this part of the exercise in rotation, points with his verge, and thus speaks, the boys repeating after him, when he requires it; answering him when he puts a question, and each drawing on the slate when required, the object described—he thus proceeds,

Teacher—One of these two straight lines is a vertical line, the other an oblique line.

The vertical line is shorter than the oblique line, and the oblique line is longer than the vertical line.

The vertical line is equal to the seventh part of one foot measure, and consequently equal to the 7th part of 12 inches.

The 7th part of 12 inches, is equal to the 7th part of 12 *wholes;* and as the 7th part of 12 wholes, is equal to 12-7ths, (twelve sevenths) the vertical line is equal to 12-7ths.

The oblique line is equal to three inches, and consequently to 3 wholes.

As 3 wholes, are equal to 21 sevenths, (21-7ths) the oblique line is equal to 21-7ths.

The vertical line being equal to 12-7, or to 4 × 3-7, (4 times three sevenths) and the oblique line to 21-7 or 7 × 3-7, (seven times three sevenths) the vertical line must be equal to 7-4ths of the oblique line.

This, it will be perceived is a perfect analysis of numbers that are fractional, but which the method disencumbers entirely of that perplexity which so much embarrasses boys in the ordinary mode of education. Several lines and figures are analysed in the same way; and the terms so much out of the common course of education, are carefully explained on their first occurrence, and applied in the explanation to the practical use; but two things are to be considered, that this perfection must be the result of considerable previous practice; and that the time employed, shows more and more perfect results than can be produced by ten years education, in any other mode. The following, is another exercise of the same class; the teacher, or the pupil whose turn it is, speaks, for be it observed, they all perform the function of teachers, in turn.

Teacher—Prepare your slates; now proceed to construct an acute angle, with a horizontal and an oblique line; make the horizontal line equal to 8 inches, and the oblique line equal to 5-7ths, (five sevenths) of the horizontal line; make the initial point of the horizontal limb coincide with the final point of the oblique limb. The following is the practical operation; a boy of 7 years old was the director in this exercise—he began thus—

Teacher—Six inches below the inner line of the upper frame of my slate, I draw a horizontal line.

[The other boys repeated, and executed by the hand, and without any rule or measure, the line required, and so they proceeded—repeating and executing after him.]

Teacher—I divide my horizontal line by means of six points or dots, into seven equal parts. [Repeated.]

Teacher—Vertically above the fourth dividing point of my horizontal line, I mark a point on my slate, which I make at the distance of 5-7ths of my horizontal line, from the initial point of my horizontal line. [Repeated.]

Teacher—From this point placed vertically above the fourth dividing point of the horizontal line, I draw an oblique line to the initial point of the horizontal line, and thus execute the angle according to the dimensions required.

This exercise leads to questions by the teacher, and the pupils are at perfect liberty to propose questions also, such as the following—

Why do you call it an acute angle? Why do you call it an oblique angle? Why is it not a right angle? Why do you say its limbs are not perpendicular? Which is the summit of this angle? &c. &c.

The following exercise followed, in calculations of numbers, executed with simplicity, and to an extent, is really surprising. A table ruled into 100 squares, or ten times ten, like the common multiplication table, but without figures, was suspended in front of the pupils; the first row was plain, the second row of squares was divided each by a line into partitions; the third row into three; and so on to ten. Each of the hundred squares was called a whole, and those squares that were divided by lines into two, three, four, five, six, or seven parts, &c. were stated to be so many parts, into which a whole could be divided, as second and third parts of a whole; or halves, thirds, fourths, &c. On this occasion the exercise taken up was 4+1-5 (or *four more one fifth.*) The arbitrary characters were previously learned by writing on the slate.

Teacher—Four more one fifth are equal to twenty-one times the twenty-second part of what number? (4+1-5=21-22 of what?)

Pupils speak—Four more one fifth are equal to 21 times the 22d of 4 more two fifths.

Teacher—How do you discover that?

Pupils—Four more 1-5th are equal to 21 times 1-5th; 21 times 1-5th are equal to 21 times the 22d part of twenty-two times one fifth; twenty-two times one fifth are equal to 22 fifths, and 22 fifths are equal to 4 times two fifths, (4+2-5.)

Teacher—4+1-5=to 21 times the 23d part of what number?

Pupil—4+1-5=to 21 times the 23d part of 4+3-5.

Teacher—How do you prove that?

Pupil—4+1-5=21×1-5....21×1-5=21-23×23×1-5....23×1-5=23-5 and 23-5=4+3-5.

The examples in my possession taken down at the time that they were passing in actual exercise. I could multiply, but for this branch of the exercises they are sufficient; for boys of 10 years old, and under; they appear very complicated, and even might seem so to people accustomed to what is commonly called cyphering; but I can assure you that they presented no more difficulty to the pupils in the Pestalozian school, than reading a chapter in a book, to a boy or girl of 14 years old, and they appeared actually to be to them an agreeable and unembarrassed sport; and the reason was obvious, they asserted not one word but what they saw in the table above mentioned, by the dexterous use of which the relations of numbers and fractional parts of numbers were clearly before their eyes; this table showed them for example, that four was 5 times the ninth part of 7+1-5.....that 7+1-5=9-2 of 1+3-5, and so on.

I shall state a few practical exercises, conducted on these principles of analysis—the following was proposed promiscuously to the first boy whose turn it was to answer—the boy in this case was only a little more than 7 years old.

Teacher—3+1-3=twice the 9th part of how many times 7-4ths—the answer was given without ten seconds reflection, in this form.

Pupil—3+1-3=2×9th part of 9 times 7-4ths less, 3-7 of seven fourths.

When called upon to explain his train of reasoning, he spoke directly, "I perceive that 3 more 1-3 are equal to ten thirds; that ten thirds are equal to

twice five thirds; that twice 5-3ds are equal to twice the ninth part of nine times five thirds; that 9 times 5-3ds are equal to forty-five thirds; and 45 thirds are equal to 15; 15 are equal to sixty fourths, (60-4) and 60-4ths are equal to 9 × 7-4 less, 8-7ths of 7 fourths, &c."

ARITHMETICAL AND MATHEMATICAL DEPARTMENT.

OF FRACTIONS.

Continued from page 335.

After the reduction to the same denominator, addition and subtraction of fractions are performed, as have been previously explained.

When these operations are to be performed upon whole numbers, with fractions accompanying them, it is best to perform them first upon the fractions. To add, for example, 3, 2-7 to 5, 4-9, the fractions 2-7 and 4-9 should first be reduced to a common denominator; they become 18 + 63 and 28 + 63; then on joining their sum to that of the whole numbers 3 and 5, the total amount is found to be 8 46-63; it may be represented at length, thus 5 + 3 + 18-63 + 28-63 = 8 46, 63.

Subtraction should be performed in the same manner, whenever the fraction attached to the number to be subtracted, is the less of the two. In the contrary case, 1 must be borrowed from the whole number to which the less fraction is joined. If, for example, it were required to take 4-5 from 3, 1-4, the two fractions reduced to the same denominator become 16-20 and 5-20, and it will be readily perceived that the first cannot be taken from the last; but after borrowing 1 or 20-20 from the whole number 3, thenumber 3, 1-4, or 3, 5-20, becomes 2, 25-20, from which 16-20 being subtracted, leaves, 2, 9-20.

Let us now attempt to deduce some new consequences, from the principles formerly established.

A fraction is multiplied or divided, as by multiplying or dividing the numerator.

A fraction is divided or multiplied, by multiplying or dividing the denominator.

It is evident, by a single inspection of this table, that a fraction may be multiplied in two ways, viz. by multiplying its numerator, or dividing its denominator; and that it may also be divided in two ways, viz. by dividing its numerator, or multiplying its denominator; whence it follows, that multiplication alone, accordingly as it is performed upon the numerator or the denominator, suffices for both the multiplication and division of fractions by whole numbers. Thus 3-15 multiplied by 7 units, make 21-15; 4-9 divided by 3, make 4-27, &c.

In the former of these two examples, the multiplier being a whole number, shows how many times the multiplicand is to be repeated; but, when it is said, for instance, that, to take the th part of a number, is to multiply it by 1-5, the word *to multiply* has not the same signification as before, since it applies to a product five times less than the multiplicand; both cases, however, may be included in the same expression, by saying, that to *multiply one number by another, is to compose a number with the first of the two, in the same way as the second is composed with unit.* In fact, when a number is to be multiplied by 2, by 3, &c. the product is composed of twice, 3 times, &c. the multiplicand in the same, as the multiplier is composed of 2, 3, &c. units; and to multiply any number by the fraction 1-5, for example, is to take a fifth part of it; because the multiplier 1-5 being a fifth part of unit, shows that the product should be a fifth part of the multiplicand.

In like manner, to multiply any number by 4-5, is to take a part of the multiplicand equal to four-fifths of it, or equal to four times one-fifth of the multiplicand.

It appears, then, that the word *to multiply*, in its application to fractionary expressions, does not always convey the idea of increase, as in the case of whole numbers. Whenever the multiplier is less than unit, the product will be less than the multiplicand; for it would only be equal to it, if the multiplier were 1.

Since the *object of multiplication by a fraction, is to take such parts of the multiplicand as are denoted by the multiplying fraction*, this operation is composed of two others, to wit, of a division and a multiplication, in which the divisor and multiplier are whole numbers.

Thus, to take 4-5 of any number, the fifth part must first be found by dividing by 5, and this fifth part must be repeated four times by multiplying by 4.

In general it appears, that *the multiplicand must be divided by the denominator of the multiplying fraction, and the result must be multiplied by its numerator.*

If the multiplicand be a whole number divisible by 5, for instance 35, the fifth part will be 7; on multiplying this result by 4, we have 28 for the 4-5 of 35, or the product of 35 by 4-5. If the multiplier, still a whole number, be not exactly divisible by 5, suppose 32, the division by 5 will give 6, 2-5 for the quotient; on repeating this quotient four times, it becomes 24, 5-8, which is equal to 25, 3-5, and shows the value of 4-5 of 32.

The change of 24, 8-5 into 25, 3-5 might have been avoided by commencing the operation with multiplying 32 by the numerator 4; the division then, of the product 128 by the denominator 5, would have produced at once the last result 25 3-5.

Let us now pass to the multiplication of a fraction by a fraction.

Suppose, for instance, that 2-3 is to be multiplied by 4-5; according to the preceding remarks, the operation reduces itself to dividing 2-3 by 5, and multiplying the result afterwards by 4, now, from the table of principles before stated, it appears that

the first operation may be performed by multiplying the denominator 3 of the multiplicand by 5, and the second, by multiplying the numerator 2 of the multiplicand by 4, which will give 8-15 for the product sought.

It would have been the same with any other example, and from what precedes, we may consequently conclude, that, *to form the product of the two fractions, the numerators must be multiplied together, and under their product, that of the two denominators must be placed.*

Whole numbers, joined with fractions, may sometimes offer themselves to be multiplied together; as, for instance, 3, 5-7 by 4, 8-9. The simplest means of obtaining the product, is to reduce the whole number to fractions; the two factors will then be expressed by 26-7 and 44-9, and their product by 1144-63 or by 18, 10-63, after separating the whole numbers.

The name of fractions of fractions, or of *compound fractions*, is sometimes given to the product of several fractions. Thus we read 2-3 of 4-5: this expression denotes 2-3 of the quantity represented by 4-5 of the original unit, taken for unit in its place. These two fractions may be reduced to a single one by multiplication, and the result 8-15 will express the value of the quantity sought, referred to the original unit; that is to say, 2-3 of the quantity represented by 4-5 of unit, are equal to 8-15 of the unit. If it were required to take 7-9 of the result, that would amount to taking 7-9 of 2-3 of 4-5, and on reducing these fractions to a single one, we should have 56-135 for the value of the quantity sought, referred to the original unit.

The word to *contain*, in strictness, does not apply to the different cases of division, any more than to *repeat* does to those presented by multiplication; for when the dividend is less than the division, it cannot be said to contain it; so that the application of this expression is only by analogy and extension.

In order to generalize division, *the dividend must be considered as composed with the quotient in the same manner as the divisor is with unit*, since the divisor and the quotient are the two factors of the dividend. This consideration is proper to every case that can be presented by division When the divisor is 5, for example, the dividend is equal to 5 times the quotient, and the quotient is consequently a fifth part of the dividend. If the divisor be a fraction, as 1-2, the dividend will be but half the quotient, or the quotient will be double the dividend.

It is plain that, whenever the divisor is less than unit, the quotient will be greater than the dividend, since this divisor must be contained in the dividend a greater number of times than unit; and unit taken for divisor, gives, in every case, a quotient expressed by the dividend itself.

The definition above settled, conducts easily to the manner of operation, whenever the divisor is a fraction; take, for instance, 4-5; in this case, the dividend should be only 4-5 of the quotient; but 1-5 being 1-4 of 4-5, we may take 1-5 of the quotient by taking a fourth of the dividend, or by dividing it by 4. Knowing thus 1-5 of the quotient, the whole of it is found by taking this result 5 times, or multiplying it by 5. In this operation, the dividend is divided by 4, and the result multiplied by 5; it is then as if 5-4 of the dividend had been taken, or as if the dividend had been multiplied by 5-4, which is nothing but the fraction 4-5 inverted

This example shows that, in general, *to divide any number whatever by a fraction, the number must be multiplied by the fraction inverted.*

It is required, for instance, to divide 9 by 3-4; it is performed by multiplying 9 by 4-3, and 36-3 or 12 is obtained. In the same manner, 13 divided by 5-7, amounts to 13 multiplied by 7-5, or to 91-5; the quotient sought is found, on separating the whole number, to be 18, 1-5.

When the dividend is a fraction, the operation is *to multiply the divided fraction, by the divisor fraction inverted.*

Let 7-8 be divided by 2-3; 7-8 must be multiplied by 3-2, which gives 21-16 equal to 1, 5-16.

The above operation may be otherwise expressed, thus. *To divide one fraction by another, the numerator of the first, must be multiplied by the denominator of the second; and the denominator of the second, by the numerator of the first.*

If any whole numbers be joined with the fractions given, this rule may be applied to them, after having reduced them to fractions.

It is important to observe, that any division whatever, whether capable of being effected in whole numbers or not, may be indicated by a fractionary expression; 36-3, for example, evidently expresses the quotient of 36 by 3, as well as 12; for 1-3 being contained three times in unit, 36-3 will be contained 3 times in 36 units, as the quotient of 36 by 3 ought to be.

It will doubtless have been remarked, that the multiplication and division of fractions may be performed immediately, from the consideration of the remarks expressed in the table of principles, while the addition and subtraction of fractions require a preliminary preparation. That depends upon this fact, that fractions spring from division, which is intimately connected with multiplication. An extended acquaintance with the science of calculation will present frequent examples of this truth—that the operations to be performed upon all quantities are the more easy, the nearer we approach to their origin.

NATIONAL ATLAS OF THE UNITED STATES.

We have twice before in our paper noticed this elegant and meritorious work; and we again take

this opportunity to bring it before our readers, by inserting the following circular from the author:

FROM THE NATIONAL RECORDER.

NATIONAL ATLAS.

Mr. H. S. Tanner, of this city, being engaged in constructing maps of the several states of the Union, intended for the New American Atlas, now publishing, and with a view of rendering the work complete and acceptable to its patrons, respectfully solicits information on the subjoined particulars. In the execution of the work in question, great labour and expense have already been bestowed in collecting from the most original and authentic sources, such materials as would assist the undertaking; yet much remains to be done, in order to exhibit a minute and satisfactory view of the geography of our country; which is so rapidly progressive, that the utmost exertions are necessary to keep pace with its improvement and the extension of our settlements. To improve the materials now in hand, and to endeavour to obtain new information on the subject, is the design of the present communication; which, it is believed, is the mode best calculated to effect the object in view, and enable the author to give a complete topographical representation of the United States, on a scale sufficiently extensive for all purposes. Gentlemen of science generally, and those especially whose professions enable them to aid the present undertaking, are more immediately addressed, and that this object, so intimately connected with our advance in geographical knowledge, may be fully accomplished, editors of periodical journals and newspapers, desirous of promoting this branch of science, are most earnestly and respectfully requested to give this article publicity. The following are the points upon which information is desired:

The recent alterations in the boundary lines of counties and townships.

New counties; their seats of justice and distance from the capitol.

Post offices, if established since the year 1818.

The latitude and longitude of new towns, and other important points.

Roads and projected canals, with the names of the streams, &c. which they are intended to connect.

Minerals, and mineral springs of recent discovery.

Soil, products, and face of the country.

Natural curiosities.

Indian antiquities, with the origin of Indian names.

The principal bridges, water falls, and light-houses.

The head of sloop navigation on the principal streams.

The altitude, situation, and course of mountains, with their local names.

Errours in existing maps, with hints for their correction.

*** Information on any of the above heads, or other intelligence which will contribute to the accuracy of the work, will be thankfully received by the publishers, Messrs. Tanner, Vallance, Kearney and Co. Philadelphia.

We sincerely rejoice to find that, amid the unexampled pecuniary embarrassment, in which our country is involved, that the Arts and Sciences continue to progress; and that in this march of the human intellect, the science of Geography receives its full attention. To know the local position of an immense country; the rich, vegetable, and mineral productions of one of the finest regions of the earth; and to behold delineated with taste and accuracy that portion of our globe where moral, political, and religious freedom is enjoyed in the highest perfection, must ever compose a respectable part of the accomplishments of an American scholar and gentleman.

We feel a pleasure in being the humble instruments of forwarding the advance of a science we so greatly value. It has ever been our opinion, that what is commonly denominated School Geography, was a deception in language. *The child learns what the adult must practice;* therefore, the same facts in Geography, as in other sciences, brought before the boy, ought to be those valuable to him when a man.

Amongst the works we have seen on the subject of Geography, printed either in Europe or America, we have met with none, comprising so nearly, what we have considered an useful compendium of Geography for all ages, as that of Mr. Thomas Ewing, of Edinburg.' We were so impressed with the value of this excellent work, that after perusal, we concluded to add it to the number of our school class books. In the arrangement of the American part of this work, we availed ourselves of the aid of Mr. William Darby, well known to the public from his productions on different parts of the United States.

In conformity to what we have already premised, we do not offer this work to the world in the common acceptation of a book for schools; we present it also as it is, a work calculated for every age of man; an epitome of Geography, History, and Chronology, arranged in a perspicuous manner, well calculated to impress upon the memory, the facts and events it records. We hope, in brief, to present this work to the American public, as a valuable accompaniment to such productions as the National Atlas, we have already described.

Whilst descanting upon the subject of Geography, we gladly avail ourselves of an opportunity of noticing Mr. Darby's intended Lectures upon Geography. To enable our readers more clearly to understand the plan and object, we insert Mr. Darby's Address, Circular, and Syllabus. Should the plan of these Lectures be judiciously carried into effect, much useful elucidation of our Geography must be the result.

DARBY'S GEOGRAPHICAL LECTURES.

The subscriber proposes to read a course of LECTURES ON THE GEOGRAPHY OF THE

UNITED STATES. The course will be composed of 30 Lectures, semi-weekly, commencing on the 7th of October, and ending about the 1st of February. Lecture days, except the Introductory Lecture, Mondays and Thursdays, between the hours of 7 and 9 o'clock, P M.

As I intend reading my Lectures with enlarged Maps, drawn and strongly marked for the purpose, a complete perspective of the natural features and territorial divisions will be displayed to the eye The rapidity with which ideas are conveyed to the mind by such sensible representations, is known to every man of common observation, and the permanency of these impressions upon the memory, decides the superiority of the method of conveying knowledge by lectures, over that of all other systems of instruction.

Accurate, and strongly defined Maps, are perhaps of all instruments of instruction, those which condense most in the smallest space; but Maps lose half their value if studied unconnectedly with verbal description. In all the geographical and statistical works in which I have been engaged, I have endeavoured to combine the two mutually accessory modes of description; in my lectures I will pursue the same system.

Though general upon the whole territory of the United States, the course will be more in detail upon the new states and territories, formed and forming in the west and south. A residence of most of my life in those regions must, independent of my peculiar pursuit while there, have given me considerable general and local knowledge, upon its natural features and political subdivisions.

The course will commence with a general view of the territory now comprised within the United States This view will be taken without any reference to the territorial lines drawn or supposed; but confined to the mere physical features; as seas, lakes, mountains, rivers, diversity of soil, and mineral and vegetable productions.

The second lecture will embrace a statistical survey of the commencement and progress of the population of the United States since the first settlement of the country. The advance of population at various preceding epocha, and its present locality and comparative density, will be shown by maps expressly prepared and coloured for the purpose; and will close with a review of the constitution of the United States.

The remaining Lectures will be arranged as the different subjects present themselves; commencing with the north-east, and following the natural position of the territorial sections as far as practicable, as may be seen in the annexed syllabus.

An introductory Lecture, containing a succinct explanation of my plan, together with the subjoined syllabus of the course, will be read at Messrs. Picket's School-room, No. 73 Vesey-street, Oct. 7, at 7 o'clock, P. M. where the attendance of gentlemen disposed to patronize the undertaking, is respectfully solicited.—A judgment can then be formed how far the *coup d'essai* may deserve public favour, or promise, in the *course*, to remunerate individual consumption of time and expense. As the intended introductory lecture will be read with a map, it will consequently exhibit specimens of both the matter and manner in which the course will be conducted.

WILLIAM DARBY.

SYLLABUS OF THE COURSE.

1. *Discovery, and relative position*, of the United States.

2 *Natural Geography.*—Seas, rivers, mountains, capes, soil, metals, minerals, fossils, &c.

3. *Territorial divisions.*

4. *Progress of Population*—Containing a view of the locality of the population at various periods, since 1750, up to the present time.

5. *Climate and seasons.*—This lecture will contain a view of the U. S. as effected by the position of its adjacent seas, the ranges of its mountain chains, and the ordinary course of the winds.

6. *The Geography of Vegetables*—Containing a recapitulation of our indigenous forest trees; our exotic orchard trees; field and garden plants; and what other plants could probably be introduced from foreign countries, and where their cultivation could be attempted with the greatest probability of success.

7. *A survey of roads, canals, routes, by rivers, and other means of conveyance by water.*—This lecture will exhibit a perspective of existing roads, where others may, and ought to be formed; canals already completed, those in progress, their position, nature of the soil, obstructions, supply of water, their benefits to the places through which they pass, and the political consequences in connecting by water different parts, otherwise separated from each other by land; and also where, and what other canals could be made advantageously.

8. *Present State of Geographical and Topographical science in the U. States.*—Review of works written in either Europe or the U. S. upon those subjects; recapitulation of maps, charts, and plans by whom made, their respective merits, and where to be procured, if for sale.

The succeeding eighteen Lectures will contain a detailed view of the different states and territories; their seas, lakes, rivers, mountains, soil, improvements, towns, villages, schools, colleges, &c. with their civil and political history and constitutions: and will proceed in the following order:

9. Maine, New Hampshire, and Vermont.
10. Massachusetts, Connecticut, and Rhode Island.
11. New-York.
12. New-Jersey.
13. Pennsylvania.
14. Maryland and Delaware.
15. Virginia.
16. Ohio.
17. Indiana, and Michigan.
18. Illinois, and the N. W. Territory.
19. Kentucky.

20. Tennessee.
21. North Carolina and South Carolina.
22. Georgia and Florida.
23. Mississippi and Alabama.
24. Louisiana and Arkansaw.
25. Missouri.
26. Missouri and Columbian Valleys or Basins.

The three following Lectures, No. 27, 28, and 29, will be composed of a view of the domestic pursuits of the inhabitants of the United States. Arts, sciences, manufactures, commerce, internal and external, value of human labour, &c.

Lecture No. 30 will close the course, by a brief recapitulation of the most important subjects descanted upon in the previous numbers.

TERMS.

Ticket for the course, $10, paid on delivery of the ticket.

Ticket for a single Lecture, 50 cents, payable on entrance at the door of the Lecture Room. Tickets for the introductory Lecture to be had from the Lecturer, or at the door of the Lecture-room, gratis.

N. B. Tickets for the course, or any single Lecture, to be had from the Lecturer, at his lodgings, 168 Broadway; or from either Mr. Albert Picket, or Mr. John W. Picket, at their respective places of abode.

Arrangements have been made with the Messrs. Pickets for the use of one of the very convenient rooms of the Manhattan School, No. 73 Vesey-street, where the course will be read.

CIRCULAR.

SIR—Any information transmitted to the author, upon the various objects intended to be embraced within the scope of the Lectures enumerated in the prefixed Syllabus, will be very thankfully received. Communications respecting the subjects of the 27th, 28th, and 29th Lectures, are particularly solicited. It is the wish of the Lecturer to embody as many well authenticated facts, as he can possibly collect, upon the general geography and statistics; but he is particularly anxious to gain and convey specific and precise detail, upon the internal resources of the United States.

Gentlemen owning, or who are acquainted with, and who will communicate an account of manufactories, their position, by what power moved, by water, steam, or otherwise, or indeed any circumstance attached to these establishments, will receive attention, and have such information as they may convey, embodied specifically in the Lectures. A similar attention will also be paid to communications upon any other subject relevant to the object of any other Lectures. An inspection of the syllabus will show that no detail upon the geography, topography, or statistics, of any of the United States, or territories, but which must be beneficial in giving full effect to such an undertaking as the intended Geographical course.

An increasing desire is manifested by the public to procure correct information respecting the new states in the West and South. Any gentleman resident in, or who has visited any of the new settlements, and who will transmit a statement of any facts he may have observed upon the geography or natural history of the country, will receive a respectful notice, and a grateful acknowledgment from the Lecturer. An early attention is solicited; but if any circumstance should prevent an individual disposed to contribute towards the object in view, from effecting his intention, within the time specified in the syllabus, when such matter would, if on hand, form a part of any given Lecture, it is hoped that such delay may not operate to prevent a transmission of the matter at any convenient moment, as such communications which have a tendency to fulfil the purport of the Lectures, can be read to the class at any time during the course.

Editors of newspapers, and other periodical publications, who feel an interest in the advancement of the geography of the United States, and who will give this address, syllabus, and circular, insertion in their respective papers, will be entitled, and receive the grateful acknowledgment of the Lecturer.

I hope, Sir, you will have the kindness to give your own assistance, and communicate the subject of this communication to any of your friends whom you may consider disposed to give aid to my pursuit.

Sir, your's respectfully,

WILLIAM DARBY.

ON FEMALE EDUCATION.

When we consider how much the happiness or misery of our lives depends upon the conduct of the weaker sex, we must acknowledge the importance of their education. No parent can expect that daughter to secure respectability to herself, or reflect credit upon him, whose mind he has permitted to remain in ignorance, whose reason has never been taught to govern her passions, or to whose understanding the evils of vice and the advantage of virtue have never been disclosed. Nature may have made her handsome, and accident rich, but if she be ignorant or vicious, she can never be useful. But the woman whose mind has been formed to the principles of virtue, and well-grounded in useful knowledge, though she may not be gifted with the allurements of high-finished beauty, or surrounded with the splendours of wealth and rank, is undoubtedly better calculated to fulfil her duties in society, and consequently more likely to promote her own happiness, and that of her connexions, than she whose principles are uninformed, whose education has been neglected, however beautiful her person, reputable her birth, or abundant her fortune.—A proper education alone can supply those requisites, so essential to a woman's usefulness in the world.—*Pittsburg Gazette.*

G. N. Baldwin's *print.*